



ISS Science : Status of Implementation Constraints

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including its large solar panel arrays and various modules, is clearly visible against the dark background of space. The Earth's blue horizon is visible at the bottom of the frame.

This is your science platform

How can you best use it?



Science Implementation Constraints

- Implementation of science during space flight is limited by various resource constraints
 - Crew time
 - Up and down mass
 - Power
 - Others
- Manage science within these constraints by experiment design, training, & ops procedures
- Limitations evolve as the mission architecture changes



Current ISS constraints

- Major tasks to date are to complete assembly and outfit ISS
 - Crew time dominated by assembly, maintenance and configuration activity
 - Limited crew size due to vehicle constraints
 - Periodic limitations to manifest (large heavy items dominate manifest priority)
- For science to date, the major limitation is available in-flight crew time and this has dominated both experiment design and ops planning



6 crew ops

- How will current situation change when we go to 6 crew ops and assembly complete?
- Good news...
 - Large working volume
 - Good on orbit facility assets (pwr, racks, etc)
 - Multi-national, complimentary equip assets
 - More available crew time for science
 - Good communication & video assets
- Not so good news...
 - Severely limited up & down mass after Shuttle retires
 - Experiment and crew re-supply
 - Equipment repair & reconfig
 - Major vehicle system repairs and upgrades
 - Limited training and preflight BDC time available
 - Severely limited post-flight BDC time



Preflight BDC and Training

- Training flow is very full and leaves limited openings for BDC
 - Ops training is in multiple locations with extensive travel required
 - US
 - Russia
 - Europe
 - Japan
- Limited equipment & significant circadian disruption limits timing of some data takes
- Limits ability to train for science and perform BDC



Postflight BDC

- Crew duty day is six hours with 2 hours required for rehab activity
- Four hours remain each day for other activity (MedOps, science, PAO, debriefs, etc.)
- Time on one day can be greater than 6 hrs if “overage” is given back the next day.
- Only limited testing possible on R+0 (typically “non-active” sessions) due to recovery ops.
- R+2 is crew day off; however, limited BDC time has been allowed on that day in the past
- Crew is to get another day off in the R+6 timeframe.
- US crew will nominally depart Russia in R+7 to R+14 day timeframe



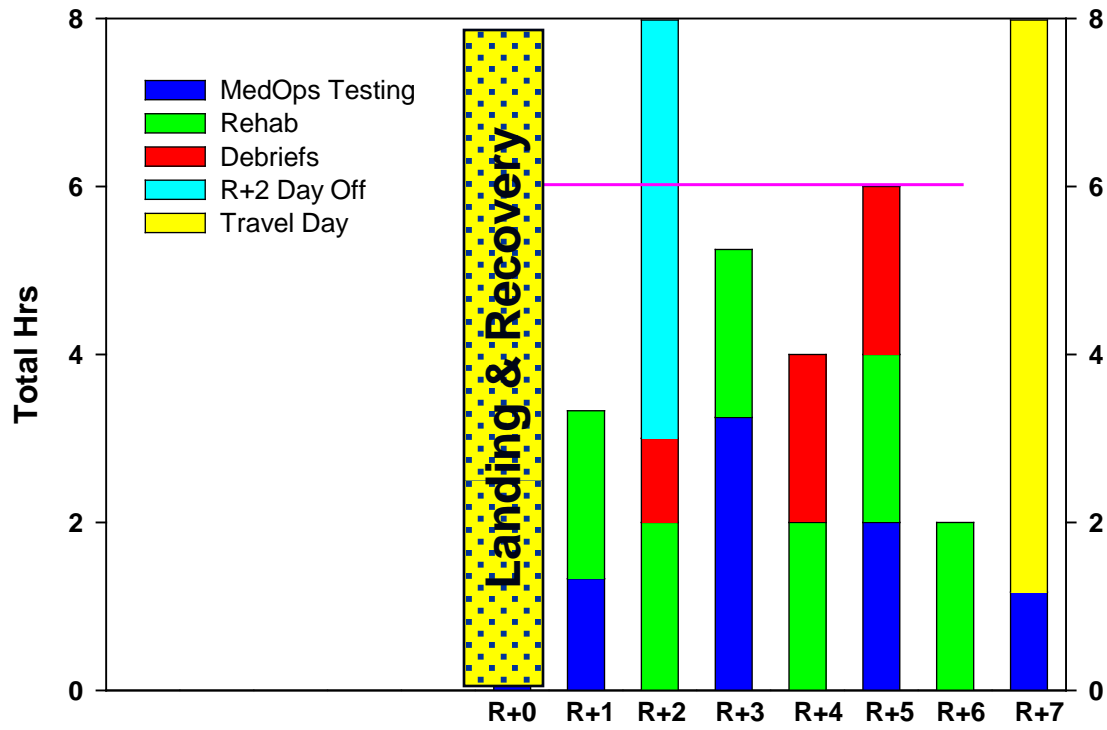
Post-flight constraints

- Why are these constraints so limiting?
 - Priority task to rehab the crew from the flight and return them to safe terrestrial function
 - Crews may look good at any point but may be generally fatigued and vulnerable to injury
 - Crew may have significant circadian disruption
 - Frequent testing can bias test results



Example Post-flight Timeline

POSTFLIGHT TIME



Post-flight available hrs = 36 hrs (R+1-6)
6 hrs/day = 4 hrs crew testing + 2 hrs Rehab
6 days at 6 hrs/day with R+2 crew day off

Total hrs:	Med Ops	6.33
	Rehab	12
	Debriefs	5
	Total Non-BDC	23.33

BDC available hrs 12.67 hrs

Crewmember day off on R+2
- 3 hours

travel prep day on R+6 - 4 hrs

So as little as 5-6 hrs may be available in week 1

R+0 day is not really available with landing in Russia – maybe 1 hr for minimally invasive testing

C. Sams - NASA



How do we manage?

- Deal to strengths
 - Timeline more flexible – test and adjust
 - Crew more interactive – talk to them
 - Train skills and guide tasks – EVA model
 - Use real time measure if possible
- Plan for reality and not an idealized picture
 - Implementation may look very different than original design (renal example)
 - Evaluate must haves vs. nice to haves for your science



Summary

- ISS assembly complete will create opportunities and impose constraints
- Move to 6 crew operations will provide more available in-flight crew time
- Time available for training and BDC will become limiting constraints
- Immediate post-flight BDC time is particularly constraining
- Program scientists and PIs need to understand and consider these factors in science design and increment planning
 - If post-flight data take is not needed for science objectives, omit it
 - If possible have data take later than R+7
- Adequate planning and thoughtful experiment design will minimize the impact of these timeline constraints